The Delphion Integrated View

Title: **JP11067474A2: DISCHARGE LAMP LIGHTING DEVICE**

Derwent Title: Discharge lamp starter - reduces output voltage of piezoelectric transformer from predefined voltage and stops its output, when lighting of discharge lamp is not confirmed [Derwent Record]

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1 page

Country: JP Japan
Kind: A (See also: JP03577904B2)

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IPC Code: Advanced: H05B 41/24;
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IPC-7: H05B 41/24;

Priority Number: 1997-08-13 JP1997000218837

Abstract:

PROBLEM TO BE SOLVED: To provide a discharge lamp lighting device provided with a double safety function to give safety in no-load condition and to prevent destruction of a piezoelectric transformer, temperature increase, deterioration, stress increase in parts, deterioration of insulating function of resin, and the likes.

SOLUTION: A timer circuit 14 is timed up after a voltage application time sufficient to start a discharge lamp RL and before the time insufficient for circuit protection and when the timer circuit 14 is timed up, a signal is transmitted to a V-F converter 12 to change the frequency of the V-F converter 12 to the frequency sufficiently higher than the resonance frequency of a piezoelectric transformer 1. A lighting judging circuit 15 judges that a discharge lamp RL is lighted when electric current flows in the discharge lamp RL and during the time electric current is detected, the timer circuit 14 is prevented from providing the V-F converter 12 with a signal of switching the driving frequency of an inverter 11 or stopping operation of the inverter 11.

INPADOC Legal Status: None **Buy Now:** Family Legal Status Report

Family:

Buy PDF	Publication	Pub. Date	Filed	Title
☑	JP11067474A2	1999-03-09	1997-08-13	DISCHARGE LAMP LIGHTING DEVICE
☑	JP03577904B2	2004-10-20	1997-08-13	
2 family members shown above				

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References:

Buy PDF	Patent	Pub.Date	Inventor	Assignee	Title
	US7064496	2006-06-20	Edamura; Koji	Mitsumi Electric Co., Ltd.	State detection device
	US6184631	2001-02-06	Noma; Takashi	Murata Manufacturing Co., Ltd.	Piezoelectric inverter
	US6151232	2000-11-21	Furuhashi; Naoki	NEC Corporation	Power supply circuit utilizing a piezoelectric transformer that supplies power to a load whose impedance varies depending on temperature

Other Abstract Info: DERABS G1999-238786 DERABS G1999-238786

The Delphion Integrated View: INPADOC Record

Title: **JP03577904B2:**

Derwent Title: Discharge lamp starter - reduces output voltage of piezoelectric transformer from predefined voltage and stops its output, when lighting of discharge lamp is not confirmed [Derwent Record]


High Resolution

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IPC-7: **H05B 41/24**;

ECLA Code: None

Priority Number: 1997-08-13 **JP1997000218837**

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☑	JP11067474A2	1999-03-09	1997-08-13	DISCHARGE LAMP LIGHTING DEVICE
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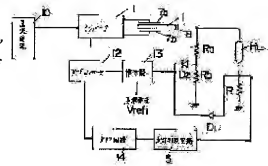
(54) DISCHARGE LAMP LIGHTING DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a discharge lamp lighting device provided with a double safety function to give safety in no-load condition and to prevent destruction of a piezoelectric transformer, temperature increase, deterioration, stress increase in parts, deterioration of insulating function of resin, and the like.



SOLUTION: A timer circuit 14 is timed up after a voltage application time sufficient to start a discharge lamp RL and before the time insufficient for circuit protection and when the timer circuit 14 is timed up, a signal is transmitted to a V-F converter 12 to change the frequency of the V-F converter 12 to the frequency sufficiently higher than the resonance frequency of a piezoelectric transformer 1. A lighting judging circuit 15 judges that a discharge lamp RL is lighted when electric current flows in the discharge lamp RL and during the time electric current is detected, the timer circuit 14 is prevented from providing the V-F converter 12 with a signal of switching the driving frequency of an inverter 11 or stopping operation of the inverter 11.

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CLAIMS

[Claim(s)]
[Claim 1] In the electric-discharge lamp lighting device which is equipped with the inverter which changes direct current voltage into alternating voltage, and the piezoelectric transformer which considers output voltage of this inverter as an input, and impresses the output voltage of this piezoelectric transformer to a electric-discharge lamp The output voltage of a piezoelectric transformer above the minimum electrical potential difference which can put a electric-discharge lamp into operation at the time of no-load or starting And a means to restrict on a predetermined electrical potential difference smaller than the electrical potential difference which a piezoelectric transformer destroys, Above electrical-potential-difference impression time amount required for positive starting of a electric-discharge lamp, and after predetermined time progress smaller than the time amount which becomes inadequate for circuit protection, The electric-discharge lamp lighting device characterized by having a means to stop a fall or generating of output voltage for the output voltage of a piezoelectric transformer rather than said predetermined electrical potential difference when lighting of a electric-discharge lamp is not checked.
[Claim 2] The electric-discharge lamp lighting device according to claim 1 characterized by adjusting output voltage of a piezoelectric transformer by frequency control.
[Claim 3] The electric-discharge lamp lighting device according to claim 2 characterized by making a frequency high and reducing the output voltage of a piezoelectric transformer when lighting of a electric-discharge lamp is not checked.
[Claim 4] The electric-discharge lamp lighting device according to claim 3 characterized by being controlled by frequency control to which it repeats returning to a high frequency after the output voltage of the piezoelectric transformer within predetermined time returns to a high frequency after carrying out the sweep to the low frequency from the high frequency, and it carries out a sweep to a low frequency again.
[Claim 5] The electric-discharge lamp lighting device according to claim 1 to 4 characterized by using quantity of electricity proportional to the amount of output voltage, or output voltage for detection of the output voltage of a piezoelectric transformer.
[Claim 6] The electric-discharge lamp lighting device according to claim 1 to 4 characterized by using the voltage obtained from the detection electrode prepared in the location where the amplitude of a piezoelectric transformer becomes detection of the output voltage of a piezoelectric transformer with abbreviation 0.
[Claim 7] The electric-discharge lamp lighting device according to claim 1 characterized by using the input voltage control means which adjusts output voltage of a piezoelectric transformer by control of input voltage.
[Claim 8] The electric-discharge lamp lighting device according to claim 7 characterized by constituting an input voltage control means from a chopper or an analog switch.
[Claim 9] Claim 7, the electric-discharge lamp lighting device of eight publications which are characterized by detecting the output voltage of a piezoelectric transformer from the amount of input

currents of a piezoelectric transformer.
[Claim 10] Predetermined time is a electric-discharge lamp lighting device according to claim 1 to 9 characterized by counting from circuit actuation time of day.
[Claim 11] Predetermined time is a electric-discharge lamp lighting device according to claim 1 to 9 characterized by counting from the time of day when the output voltage of a piezoelectric transformer reached the predetermined electrical potential difference.
[Claim 12] The electric-discharge lamp lighting device according to claim 4 characterized by being in agreement with time amount when the count to which the output voltage of a piezoelectric transformer reached [predetermined time] the predetermined electrical potential difference turns into a count of predetermined.
[Claim 13] The electric-discharge lamp lighting device according to claim 1 to 12 which carries out the description of stopping an output after reducing the output voltage of a piezoelectric transformer rather than a predetermined electrical potential difference, when lighting of a electric-discharge lamp is not checked.
[Claim 14] The electric-discharge lamp lighting device according to claim 1 to 13 characterized by using the circuit which performs feedback control of the load current as an inverter.
[Claim 15] The electric-discharge lamp lighting device according to claim 14 characterized by making the means of lighting distinction of a electric-discharge lamp serve a double purpose with the means of the feedback control of the load current.
[Claim 16] Claim 14, the electric-discharge lamp lighting device of 15 publications which are characterized by constituting from a V-F converter to which the load current is detected for the means of the feedback control of the load current, and the drive frequency of an inverter is changed in response to the output voltage of the integrator in comparison with reference voltage, and this integrator.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the electric-discharge lamp lighting device which used the piezoelectric transformer.
[0002]
[Description of the Prior Art] As a electric-discharge lamp lighting device using a piezoelectric transformer, conventionally JP,6-167694,A etc. is known, the principle of operation is a electric-discharge lamps', such as cold cathode tube's, lighting front and after lighting, and the internal impedance changes a lot. The property in which it can receive needing high pressure before also turning on the electrical potential difference to need, and after lighting can be driven on a comparatively low electrical potential difference, and a piezoelectric transformer with the impedance of a load The property (the electrical potential difference generated, so that the impedance of a load is large becomes large) in which the electrical potential differences to generate differ is fitted.
[0003] However, when it is made to operate in the condition that a load is not connected, an apparent output impedance becomes infinite and the high voltage according to a load will continue being outputted from the property of a piezoelectric transformer. For example, when the lighting electrical potential difference of an about [load impedance 100Kohm] cold cathode tube is about 500V, the output voltage at the time of no-load (load impedance infinity) becomes one about ten times the high voltage of 5kV - about 10kV of this.
[0004] When such a high voltage continues being outputted from a piezoelectric transformer, enlargement of the block substrate for preventing dielectric breakdown with the components within a circuit block etc. is needed. Moreover, in the condition of having generated such a high voltage, the amplitude of a piezoelectric transformer becomes very large and there is a possibility that a piezoelectric transformer may be destroyed for stress fault size. Moreover, in order to make a electric-discharge lamp turn on certainly, the time amount which impresses starting voltage and its starting voltage is fully needed.
[0005] Generating of such a high voltage is prevented and there is JP,8-33350,A as an example of the electric-discharge lamp lighting device using the piezoelectric transformer which gives starting voltage sufficient time. The configuration is shown in drawing 21 . The end 5 of DC input terminal is connected to one side of the primary coil of Transformer T for this circuit, and the other end 6 is grounded. In order to connect another side of the primary coil of Transformer T to the collector (drain) of switching device Q, to ground the emitter (source) of switching device Q and to protect this switching device Q, it is the protection diode D0. It reverse-connects between collector (drain)-emitters (source). It connects with one primary electrode 7a of the mechanical component of a piezoelectric transformer 1, and one side of the secondary coil of Transformer T is grounded while another side of a secondary coil is similarly connected to primary electrode 7b of another side of the mechanical component of a piezoelectric transformer 1. The output of a piezoelectric transformer 1 is connected with the load slack electric-discharge lamp RL, and the other end of a electric-discharge lamp RL is grounded through the detection

resistance R. And in the node of a electric-discharge lamp RL and the detection resistance R, it is diode D1. The anode side is connected and it is this diode D1. The cathode side is inputted into the integrator 2. The output of an integrator 2 is inputted into V-F KOMPATA 3, and the end of the partial pressure resistance Ra and Rb connected to the serial is connected at the node of the . one side and piezoelectric transformer 1 and the electric-discharge lamp RL by which the output of V-F KOMPATA 3 is connected to switching device Q. The other end of the series circuit of these partial pressure resistance Ra and Rb is grounded. And in the node of these two partial pressure resistance Ra and Rb, it is diode D2. The anode side is connected, it connects with the integrator 2 and, thereby, that cathode side constitutes the overvoltage protection circuit 4.

[0006] In such a circuit, when the electric-discharge lamp RL is connected, usually Load current IL Flow, and change this into an electrical potential difference by the detection resistance R, and it is detected. Diode D1 By rectifying, inputting into an integrator 2 as direct current voltage, giving the detected electrical potential difference to V-F converter 3, and changing the output frequency Switching device Q changes drive frequency, adjustable [of the output voltage of a piezoelectric transformer 1] is carried out, and it controls to obtain a predetermined output.

[0007] if a circuit is made to **** in the condition of not connecting a electric-discharge lamp RL here, the load impedance of a piezoelectric transformer 1 is infinite seemingly -- becoming -- moreover -- usually -- the load current IL the detection resistance R -- detecting -- diode D1 the electrical potential difference obtained -- the load current IL in order not to flow -- 0 -- it is set to V, and the output of an integrator 2 operates so that the output frequency of V-F KOMPATA 3 may be made low. That is, it works so that the output voltage of a piezoelectric transformer 1 may become high.

[0008] If the output voltage of a piezoelectric transformer 1 turns into a high voltage, the electrical potential difference which is proportional to this output voltage also at the midpoint of the partial pressure resistance Ra and Rb by which series connection is carried out between the outgoing end of this piezoelectric transformer 1 and the grounding conductor will appear. When a piezoelectric transformer 1 is unloaded condition, these partial pressure resistance Ra and Rb has set up the division ratio so that a predetermined electrical potential difference may be obtained. And the electrical potential difference by which the partial pressure was carried out is diode D2. While being changed into a direct current, it is diode D2. A forward voltage drop is received. therefore -- if the electrical potential difference which is not impressed in the condition that the usual electric-discharge lamp RL is connected will be in unloaded condition -- detection diode D3 from -- it will be given to an integrator 2, and operates in the direction in which V-F converter 3 makes a frequency high with this electrical potential difference, and the output voltage of a piezoelectric transformer 1 declines.

[0009] Therefore, at the time of no-load, the output voltage of a piezoelectric transformer 1 has it prevented to become a high voltage, and is stopped by predetermined output voltage. It is VH about this predetermined electrical potential difference. If it carries out, at unloaded condition, the output voltage of a piezoelectric transformer 1 is the predetermined electrical potential difference VH, as shown in drawing 22 . It continues being maintained. In addition, output voltage in case this overvoltage protection does not exist is shown by the inside a and b of drawing 22 .

[0010]

[Problem(s) to be Solved by the Invention] However, output voltage VH to which this piezoelectric transformer 1 is set It must be sufficient electrical potential difference for the electric-discharge lamp RL which is a load at least to start. 1.5kV or more of starting voltage at least is required to start even -10-degree C low temperature certainly in the case of a cold cathode tube. Moreover, in the case of a neon tube, starting voltage is still more nearly required, and 3kV or more is needed for it at least.

[0011] That is, in the conventional example shown by drawing 21 and drawing 22 , in order to carry out starting lighting of a cold cathode tube or the neon tube certainly, output voltage will continue occurring [the electrical potential difference of at least 1.5kV - about 3kV] in unloaded condition. Therefore, when people are going to connect or exchange a electric-discharge lamp RL, there is a possibility of receiving an electric shock to the high voltage with an output voltage [of this piezoelectric transformer 1] of 1.5kV - 3kV, and it is very dangerous.

[0012] Moreover, although it is smaller than the high voltage of 5kV - about 10kV when not controlling output voltage when the output voltage of a piezoelectric transformer is maintained by 1.5kV - about 3kV, the amplitude of a piezoelectric transformer 1 becomes large and a temperature rise and degradation of a piezoelectric transformer 1 (the life of a piezoelectric transformer 1 is brought forward) pose a problem from the time of making a electric-discharge lamp RL turn on. Moreover, I hear that the current given to a piezoelectric transformer 1 increases, the amplitude of a piezoelectric transformer 1 sometimes becomes large, and the inductance component and switching device which are used for the circuit which drives a piezoelectric transformer 1 are also affected.
[0013] If the output voltage of 1.5 morekV - about 3kV continues occurring, the insulating engine performance of resin will be lowered in response to the effect of corona discharge, and it will become an insurance top problem. Furthermore, a electric-discharge lamp RL is connected again, and since a load becomes infinite and the output voltage of a piezoelectric transformer 1 rises when it is in a lighting condition, and a electric-discharge lamp RL separates in a certain abnormalities, in the circuitry of the conventional example, it works in the direction which output voltage is reduced and carries out a frequency to like highly. However, as shown in drawing, when it has shifted the resonance peak at the time of an owner load (a broken line shows) to a low frequency side from the resonance peak at the time of no-load (a continuous line shows) as the resonance characteristic over the load of a piezoelectric transformer 1 is shown in drawing 23 , and a electric-discharge lamp RL is in the condition of ** near resonance frequency during lighting (at the time of an owner load) and it becomes no-load suddenly, it moves to the condition of ** on the left-hand side of the response curve at the time of no-load. ** In the condition, if the high voltage occurs, an electrical potential difference will be reduced, and carry out a frequency to like highly, and it is a programmed voltage VH. Suppose that it changes in the condition of **. In case it moves to the condition of this ** to **, it will pass along the crest of the resonance at the time of no-load, and a piezoelectric transformer 1 will generate the high voltage of 5kV - about 10kV. thereby -- the amplitude of a piezoelectric transformer -- very much -- large -- becoming -- stress -- excessive -- 3 -- there is fear just.
[0014] Moreover, in the case of lambda mode ROZEN mold with which the piezoelectric transformer 1 of drawing 21 is generally known, a secondary output is the amplitude (I among drawing) like drawing 24 . RO -- being shown, if the output voltage of a piezoelectric transformer 2 is maintained by 1.5kV - about 3kV according to unloaded condition as it is the part which becomes the largest and was shown above The amplitude of a piezoelectric transformer 1 becomes larger than a lighting condition, that is, the amplitude of a secondary output also becomes large, and possibility that connection ****** will separate from the secondary output section and a electric-discharge lamp RL from the secondary secondary output section slack electrode 8 becomes large. When copper wire 9 separates from join 8a, in the conventional example, detection of output voltage becomes impossible, a frequency is made low and it goes, and a piezoelectric transformer 1 will generate the high voltage of 5kV - about 10kV, and has a possibility of destroying for stress fault size.
[0015] Succeeding in this invention in view of the above-mentioned trouble, the place made into the purpose is to offer the electric-discharge lamp lighting device equipped with the double safeguard which prevents destruction of the safety in unloaded condition, and a piezoelectric transformer, a temperature rise, degradation, the increment in stress of components, the insulating performance degradation of resin, etc.
[0016]
[Means for Solving the Problem] In order to attain the above-mentioned purpose in invention of claim 1 In the electric-discharge lamp lighting device which is equipped with the inverter which changes direct current voltage into alternating voltage, and the piezoelectric transformer which considers output voltage of this inverter as an input, and impresses the output voltage of this piezoelectric transformer to a electric-discharge lamp The output voltage of a piezoelectric transformer above the minimum electrical potential difference which can put a electric-discharge lamp into operation at the time of no-load or starting And a means to restrict on a predetermined electrical potential difference smaller than the electrical potential difference which a piezoelectric transformer destroys, Above electrical-potential-

difference impression time amount required for positive starting of a electric-discharge lamp, and after predetermined time progress smaller than the time amount which becomes inadequate for circuit protection, When lighting of a electric-discharge lamp is not checked, it is characterized by having a means to stop a fall or generating of output voltage for the output voltage of a piezoelectric transformer rather than said predetermined electrical potential difference.

[0017] In invention of claim 2, it is characterized by adjusting output voltage of a piezoelectric transformer by frequency control in invention of claim 1. In invention of claim 3, in invention of claim 2, when lighting of a electric-discharge lamp is not checked, it is characterized by making a frequency high and reducing the output voltage of a piezoelectric transformer.

[0018] In invention of claim 4, after returning to a high frequency after the output voltage of the piezoelectric transformer within predetermined time carried out the sweep to the low frequency from the high frequency in invention of claim 3, and carrying out a sweep to a low frequency again, it is characterized by being controlled by frequency control which repeats returning to a high frequency. In invention of claim 5, it is characterized by using quantity of electricity proportional to the amount of output voltage, or output voltage for detection of the output voltage of a piezoelectric transformer in claim 1 thru/or invention of 4.

[0019] In invention of claim 6, it is characterized by using the voltage obtained from the detection electrode prepared in the location where the amplitude of a piezoelectric transformer becomes detection of the output voltage of a piezoelectric transformer with abbreviation 0 in claim 1 thru/or invention of 4. In invention of claim 7, it is characterized by using the input voltage control means which adjusts output voltage of a piezoelectric transformer by control of input voltage in invention of claim 1.

[0020] In invention of claim 8, it is characterized by constituting an input voltage control means from a chopper or an analog switch in invention of claim 7. In invention of claim 9, it is characterized by detecting the output voltage of a piezoelectric transformer from the amount of input currents of a piezoelectric transformer in invention of claims 7 and 8. By invention of claim 10, predetermined time is claim 1 characterized by counting from circuit actuation time of day thru/or 9.

[0021] In invention of claim 11, it is characterized by counting predetermined time from the time of day when the output voltage of a piezoelectric transformer reached the predetermined electrical potential difference in claim 1 thru/or invention of 9. In invention of claim 12, it is characterized by being in agreement with time amount when the count to which the output voltage of a piezoelectric transformer reached [predetermined time] the predetermined electrical potential difference in invention of claim 4 turns into a count of predetermined.

[0022] In invention of claim 13, in claim 1 thru/or invention of 12, when lighting of a electric-discharge lamp is not checked, after reducing the output voltage of a piezoelectric transformer rather than a predetermined electrical potential difference, the description of stopping an output is carried out. In invention of claim 14, it is characterized by using the circuit which performs feedback control of the load current as an inverter in claim 1 thru/or invention of 13.

[0023] In invention of claim 15, it is characterized by making the means of lighting distinction of a electric-discharge lamp serve a double purpose with the means of the feedback control of the load current in invention of claim 14. It is characterized by constituting from invention of claim 16 with the V-F converter to which the load current is detected for the means of the feedback control of the load current, and the drive frequency of an inverter is changed in claims 14 and 15 in response to the output voltage of the integrator in comparison with reference voltage, and this integrator.

[0024]

[Embodiment of the Invention] Hereafter, an operation gestalt explains this invention.

(Operation gestalt 1) Drawing 1 shows the circuitry of this operation gestalt. In drawing, it connects with an inverter 11, and the inverter 11 has connected the output to the primary electrodes 7a and 7b of a piezoelectric transformer 1, and DC power supply 10 amplify the signalling frequency from V-F converter 12 to a wave required for the drive of a piezoelectric transformer 1, and drive a piezoelectric transformer 1. The electric-discharge lamp RL which is a load connects an end to the secondary electrode 8 of a piezoelectric transformer 1, the other end is grounded through the detection resistance R,

and the electrical potential difference by which the pressure up was carried out with the piezoelectric transformer 1 is impressed. In the node of a electric-discharge lamp RL and the detection resistance R, it is diode D1. An anode side is connected and it is this diode D1. The cathode side is connected to the integrator 13. The load current detected by the detection resistance R is diode D1. It is changed into the electrical potential difference rectified by minding, goes into an integrator 13, and is reference voltage Vref1. It is compared and the output voltage according to the difference is given to V-F converter 12 from an integrator 13. V-F converter 12 changes a frequency according to the electrical potential difference given from the integrator 13, and gives the signalling frequency to an inverter 11.

[0025] On the other hand, the other end of the series circuit of the partial pressure resistance Ra and Rb where the end was grounded is connected at the node of a piezoelectric transformer 1 and a electric-discharge lamp RL. And in the node of these two partial pressure resistance Ra and Rb, it is diode D2. The anode side is connected and that cathode side is connected to the integrator 13. When a piezoelectric transformer 1 is unloaded condition, these partial pressure resistance Ra and Rb has set up the division ratio so that a predetermined electrical potential difference may be obtained.

[0026] Moreover, if the output of a timer circuit 14 is connected to V-F converter 12, a timer circuit 14 is after sufficient electrical-potential-difference impression time amount progress for a electric-discharge lamp RL to start, and the deadline of it is passed before it serves as a period inadequate for circuit protection, and the deadline of is passed on the other hand, a signal will be given to V-F converter 12 and the frequency of V-F converter 12 will be switched to a frequency sufficiently higher than the resonance frequency of a piezoelectric transformer 1 (or if the deadline of a timer circuit 14 is passed, it will stop V-F converter 12). Moreover, the outgoing end of the lighting distinction circuit 15 is connected to the timer circuit 14. the if the input edge of the lighting distinction circuit 15 is connected with a electric-discharge lamp RL at a node with the detection resistance R and a current flows to a electric-discharge lamp RL, while judging that the electric-discharge lamp RL had turned on the lighting distinction circuit 15 and having detected the current timer circuit 14 -- V-F converter 12 -- frequency switch (or stop giving signal of halt) ** -- it is like.

[0027] Next, actuation of this operation gestalt is explained to a detail. If circuit actuation is made to start when the electric-discharge lamp RL is connected, by a timer circuit 14 operating first, to it and coincidence, it will operate so that the output of an integrator 13 may begin to carry out a sweep to a frequency with the low signalling frequency of V-F converter 12, since the current is not flowing at first, therefore the output voltage of a piezoelectric transformer 3 will rise, and a load 4 will light up. When a electric-discharge lamp RL lights up, the load current flows and it is made for the lighting distinction circuit 15 not to give the output signal after deadline of a timer circuit 14 to V-F converter 12. Moreover, the load current is reference voltage Vref0 with an integrator 13. The output frequency of V-F converter 12 is controlled to become the compared predetermined current.

[0028] Next, the circuit actuation by the unloaded condition which does not connect a electric-discharge lamp RL is explained using drawing 2 (a) and (b). If way actuation is made to start this time, a timer circuit 14 will operate first like the above, and it is begun to count time amount. To coincidence, a frequency begins a sweep to the lower one, as shown in drawing 2 (a), and the output voltage of a piezoelectric transformer 1 rises. Since it is unloaded condition, output voltage continues rising, and it is the predetermined electrical potential difference (electrical potential difference which can put a electric-discharge lamp RL into operation also at low temperature) VH. If it reaches (time amount t1), the electrical potential difference the partial pressure was carried out [the electrical potential difference] by the partial pressure resistance Ra and Rb is given to an integrator 13 through diode D2, the output frequency of V-F converter 12 is made high, and output voltage is VH. It controls not to become above.

[0029] Thus, output voltage is VH. Time amount t2 after being maintained at abbreviation regularity and reaching impression time amount <= (t2-t1) of starting voltage required for positive starting lighting of a electric-discharge lamp RL, before becoming time amount inadequate for circuit protection A timer circuit 7 passes the deadline of, the output frequency of V-F converter 12 is switched to a high frequency, and output voltage is reduced (drawing 2 (a)). Or time amount t2 When a timer circuit 14 passes the deadline of, V-F converter 12 is stopped, a circuit is stopped in operation, and an output is set

to 0 (drawing 2 (b)).
[0030] It is not continued to the time amount which can supply by this the electrical potential difference which can carry out starting lighting of the electric-discharge lamp RL at the time of low temperature, and becomes inadequate [the high power condition of a piezoelectric transformer 1] for circuit protection at the time of no-load, and the increment in stress of destruction of a piezoelectric transformer 1, a temperature rise, degradation and the switching device of an inverter 11, and an inductance component, the insulation deterioration of resin components, etc. are prevented.
[0031] There is no risk of, of course people receiving an electric shock in high pressure of several kV, and it is safe. moreover, when a electric-discharge lamp RL is connected at first and a electric-discharge lamp RL separates in a certain abnormalities during lighting, the load current which was flowing to the electric-discharge lamp RL becomes zero, and detect that the load current is zero and, as for the lighting distinction circuit 15, a timer circuit 14 gives a switch of a frequency, or the signal of a halt to V-F converter 12 -- starting -- immediately -- a limit of output voltage -- or it stops in operation. At this time, without [therefore] passing along a resonance peak, since the sweep of a frequency like the conventional example is not carried out, very high output voltage does not occur and a switch of a frequency can prevent destruction of a piezoelectric transformer 1.
[0032] Even if the connection of the output section of a piezoelectric transformer 1 separates and it becomes impossible for output voltage to detect by the partial pressure resistance Ra and Rb, it is time amount t2. Since an output is restricted or stopped, a circuit is protected.
(Operation gestalt 2) Drawing 3 shows the circuit of this operation gestalt. In drawing, it connects with an inverter 11, and the inverter 11 has connected the output to the primary electrodes 7a and 7b of a piezoelectric transformer 1, and DC power supply 10 amplify the signalling frequency from V-F converter 12 to a wave required for the drive of a piezoelectric transformer 1, and drive a piezoelectric transformer 1. The electric-discharge lamp RL which is a load connects an end to the secondary electrode 8 of a piezoelectric transformer 1, the other end is grounded through the detection resistance R, and the electrical potential difference by which the pressure up was carried out with the piezoelectric transformer 1 is impressed. In the node of a electric-discharge lamp RL and the detection resistance R, it is diode D1. An anode side is connected and it is this diode D1. The cathode side is connected to the integrator 13. The load current detected by the detection resistance R is diode D1. It is changed into the electrical potential difference rectified by minding, goes into an integrator 13, and is reference voltage Vref1. It is compared and the output voltage according to the difference is given to V-F converter 12 from an integrator 13. V-F converter 12 changes an output frequency according to the electrical potential difference given from the integrator 13, and gives the signalling frequency to an inverter 11.
[0033] On the other hand, the other end of the series circuit of the partial pressure resistance Ra and Rb where the end was grounded is connected at the node of a piezoelectric transformer 1 and a electric-discharge lamp RL. And in the node of these two partial pressure resistance Ra and Rb, it is diode D2. The anode side is connected and that cathode side is connected to the comparator 16. When a piezoelectric transformer 1 is unloaded condition, these partial pressure resistance Ra and Rb has set up the division ratio so that a predetermined electrical potential difference may be obtained. A comparator 16 is reference voltage vref2. Diode D2 If the partial pressure electrical potential difference (detection electrical potential difference) of the partial pressure resistance Ra and Rb inputted by minding is compared and the output voltage of a piezoelectric transformer 1 becomes more than a predetermined electrical potential difference, the output frequency of V-F converter 12 will be switched to a frequency sufficiently higher than the resonance frequency of a piezoelectric transformer 1.
[0034] Moreover, on the other hand, the output of a timer circuit 14 will be connected to V-F converter 12, and a timer circuit 14 is after sufficient electrical-potential-difference impression time amount progress for a electric-discharge lamp RL to start, and before it serves as a period inadequate for circuit protection, the deadline of it is passed, and if the deadline of is passed, it will give a signal to V-F converter 12, and will switch the output frequency of V-F converter 12 to a frequency sufficiently higher than the resonance frequency of a piezoelectric transformer 1. Or if the deadline of a timer circuit 14 is passed, it will stop V-F converter 12. Moreover, the outgoing end of the lighting distinction circuit 15 is

connected to the timer circuit 14. If the input edge of the lighting distinction circuit 15 is connected with a electric-discharge lamp RL at a node with the detection resistance R and a current flows to a electric-discharge lamp RL, while judging that the electric-discharge lamp RL had turned on the lighting distinction circuit 15 and having detected the current, a timer circuit 14 will stop giving the signal of a frequency switch (or halt) to V-F converter 12.

[0035] Next, actuation of this operation gestalt is explained to a detail. In addition, since actuation when the electric-discharge lamp RL is connected is the same as the operation gestalt 1, it is omitted here, and the circuit actuation by the unloaded condition to which the electric-discharge lamp RL is not connected is explained using drawing 4 (a) and (b). If way actuation is made to start this time, a timer circuit 14 will operate first like the above, and it is begun to count time amount. To coincidence, as shown in drawing 4 (a), a sweep is begun to the one where a frequency is lower, and the output voltage of a piezoelectric transformer 1 rises. Since it is unloaded condition, output voltage continues rising, and it is time amount t1. Predetermined electrical potential difference VH If it reaches, a comparator 16 will switch the output frequency of V-F converter 12 to a high frequency, and will reduce output voltage. If output voltage declines, it is canceled, a sweep is begun to the one where a frequency is lower again, output voltage begins to rise, and actuation of a comparator 16 is the predetermined electrical potential difference VH. If it reaches, a comparator 16 will switch the output frequency of V-F converter 12 to a high frequency, and will reduce output voltage. Time amount t2 after repeating this actuation below and giving the impression time amount of starting voltage required for positive starting lighting of a electric-discharge lamp RL, before becoming time amount inadequate for circuit protection A timer circuit 14 passes the deadline of, the output frequency of V-F converter 12 is switched to a high frequency, and output voltage is reduced (drawing 4 (a)). moreover -- or time amount t2 When a timer circuit 7 passes the deadline of, actuation of V-F converter 12 is stopped, a circuit is stopped substantially, and an output is made into zero (drawing 4 (b)).

[0036] The increment in stress for destruction, a temperature rise, degradation and a switching device, an inductance component, etc. of a piezoelectric transformer 1, insulating degradation of resin components, etc. are prevented without being continued to the time amount which can supply by this the electrical potential difference which can perform starting lighting of a electric-discharge lamp RL at the time of low temperature, and becomes inadequate [the high power condition of a piezoelectric transformer 1] for circuit protection also in no-load. Of course, risk of people receiving an electric shock in high pressure of several kV is [nothing] and is safe.

[0037] furthermore, the operation gestalt 1 -- like -- predetermined electrical potential difference VH the condition (high power condition) of having generated -- time amount t1 from -- t2 It does not continue in between. the burst wave to which output voltage made the electrical potential difference VH maximum like drawing 4 (a) -- becoming -- **** -- electrical potential difference VH the condition (high power condition) of having generated -- time amount t1 from -- t2 Since it is only generating intermittently in between As compared with the operation gestalt 1, there are little stress to a piezoelectric transformer 1 and stress to the switching device of an inverter 11 etc., and they end.

[0038] Moreover, it is time amount t2 like drawing 4 (b). When stopping actuation of V-F converter 12, or when stopping the drive of the switching device in an inverter 11, stress may be generated in a switching device by intercepting suddenly the current which was flowing to the switching device. Output voltage is an electrical potential difference VH like especially the operation gestalt 1. When stopping in the time of high power, a switching device will be broken in the condition that the larger current is flowing, and it is expected that the stress generated in a switching device becomes large. on the other hand, a burst wave as shows output voltage to drawing 4 (b) with this operation gestalt -- it is -- time amount t2 the time of making it stop -- output voltage -- electrical potential difference VH it is -- there is almost no probability and it is shown in drawing 4 (b) -- as -- electrical potential difference VH The probability stopped at the time of small output voltage is high, and can make small stress of the switching device at the time of a halt.

[0039] Moreover, the actuation the case where it separates while the electric-discharge lamp RL lit up, and in the case of the blank of the output section of a piezoelectric transformer 1, and the operation

effectiveness are the same as the operation gestalt 1.
This operation gestalt does not connect the end of the partial pressure resistance Ra and Rb in the operation gestalten 1 and 2 at the node of a piezoelectric transformer 1 and a electric-discharge lamp RL. (Operation gestalt 3) As shown in drawing 5 , the detection electrode 17 is formed in a piezoelectric transformer 1 as the 3rd electrode, the end of partial pressure resistance Ra' and Rb' is connected to this detection electrode 17, and, as for this detection electrode 17, the amplitude between the primary electrodes 7a and 7b of a piezoelectric transformer 1 and the secondary electrode 8 is prepared in the front face of abbreviation 0 and the knot section A. For this reason, in the detection electrode 17, it is proportional to the electrical potential difference generated in a secondary electrode, and an electrical potential difference smaller than secondary output voltage occurs. Partial pressure resistance Ra' and Rb' detect this detection electrical potential difference, and it is controlled like the operation gestalt 1 and the operation gestalt 2. The division ratio is set up so that output voltage partial pressure resistance Ra' and predetermined when the piezoelectric transformer 1 of Rb' is unloaded condition may be obtained.
[0040] At this time, since the detection electrode 17 is formed in the front face of the knot section A on which the amplitude of a piezoelectric transformer 1 serves as abbreviation 0, the amplitude of the part of the detection electrode 17 is abbreviation 0, partial pressure resistance Ra' and a fear of connection of Rb' separating do not have it at the time of high power, and it is more safe for it from the detection electrode 17. Moreover, the electrical potential difference generated in the detection electrode 17 can be smaller than the output voltage generated in the secondary electrode 8 of a piezoelectric transformer 1, and partial pressure resistance Ra' and Rb' can lower the proof-pressure engine performance rather than the partial pressure resistance Ra and Rb of the operation gestalten 1 and 2. For example, since the proof-pressure engine performance is secured, the number is [having connected two or more resistance] reducible.
[0041] In addition, except the configuration shown in drawing 5 , since it applies to the operation gestalt 1 or the configuration of 2, it omits with reference to drawing 1 or drawing 3 here.
(Operation gestalt 4) Drawing 6 shows the circuit of this operation gestalt. drawing -- setting -- between DC power supply 10 and inverters 11 -- a chopper 21 -- preparing -- between this chopper 21 and inverters 11 -- diode D3 an anode -- connecting -- this diode D3 The cathode is connected to the PWM control circuit 22.
[0042] The PWM control circuit 22 is diode D3 about the output (input voltage of an inverter 11) of a chopper 21. A chopper 21 is controlled so that it minds, and it feeds back and the output (input voltage of an inverter 11) of a chopper 21 becomes fixed. The inverter 11 has connected the output to the primary electrodes 7a and 7b of a piezoelectric transformer 1 like the operation gestalt 1, amplifies the signalling frequency from V-F converter 12 to a wave required for the drive of a piezoelectric transformer 1, and drives a piezoelectric transformer 1. The electric-discharge lamp RL which is a load connects an end to the secondary electrode 8 of a piezoelectric transformer 1, the other end is grounded through the detection resistance R, and the electrical potential difference by which the pressure up was carried out with the piezoelectric transformer 1 is impressed. In the node of a electric-discharge lamp RL and the detection resistance R, it is diode D1. An anode side is connected and it is this diode D1. The cathode side is connected to the integrator 13. The load current detected by the detection resistance R is diode D1. It is changed into the electrical potential difference rectified by minding, goes into an integrator 13, and is reference voltage Vref1. It is compared and the output voltage according to the difference is given to V-F converter 12 from an integrator 13. V-F converter 12 changes an output frequency according to the electrical potential difference given from the integrator 13, and gives the signalling frequency to an inverter 11.
[0043] On the other hand, the other end of the series circuit of the partial pressure resistance Ra and Rb where the end was grounded is connected at the node of a piezoelectric transformer 1 and a electric-discharge lamp RL. And in the node of these two partial pressure resistance Ra and Rb, it is diode D2. The anode side is connected and that cathode side is connected to the PWM control circuit 22. When a piezoelectric transformer 1 is unloaded condition, these partial pressure resistance Ra and Rb has set up the division ratio so that a predetermined electrical potential difference may be obtained.

[0044] The PWM control circuit 22 is diode D2 at the time of unloaded condition. A predetermined electrical potential difference is made to fixed-ize the detection electrical potential difference by the partial pressure resistance Ra and Rb inputted by minding, a chopper 21 is controlled as like, and the output (input voltage of an inverter 11) of a chopper 21 is adjusted. Moreover, if the output of a timer circuit 14 is connected to the PWM control circuit 22, a timer circuit 14 is after sufficient electrical-potential-difference impression time amount progress for a electric-discharge lamp RL to start, and the deadline of it is passed before it serves as a period inadequate for circuit protection, and the deadline of is passed on the other hand, a signal will be given to the PWM control circuit 22 and the drive of a chopper 21 will be stopped (or if the deadline of a timer circuit 14 is passed, it will give a signal to the PWM control circuit 22, and will make the output of a chopper 11 very small).
[0045] Moreover, the output of the lighting distinction circuit 15 is connected to the timer circuit 14. If the input of the lighting distinction circuit 15 is connected with a electric-discharge lamp RL at a node with the detection resistance R and a current flows to a electric-discharge lamp RL, while judging that the electric-discharge lamp RL had turned on the lighting distinction circuit 15 and having detected the current, a timer circuit 14 will stop giving the signal of a frequency switch or a halt to V-F converter 12.
[0046] Next, actuation of this operation gestalt is explained to a detail. In addition, since actuation when the electric-discharge lamp RL is connected is the same as the operation gestalt 1, it is omitted here, and the circuit actuation by the unloaded condition to which the electric-discharge lamp RL is not connected is explained using drawing 7 (a) and (b). If way actuation is made to start this time, a timer circuit 14 will operate first like the above, and it is begun to count time amount. To coincidence, a frequency begins a sweep to the lower one, as shown in drawing 7 (a), and the output voltage of a piezoelectric transformer 1 rises. Since it is unloaded condition, output voltage continues rising, and it is time amount t1. Predetermined electrical potential difference VH It reaches and is this electrical potential difference VH. When it is going to exceed, the detection electrical potential difference by the partial pressure resistance Ra and Rb is DAIODO D2. It minds, is inputted into the PWM control circuit 22, and is the predetermined electrical potential difference VH about output voltage. The PWM control circuit 22 controls a chopper 21 so that the output of a chopper 21 declines to maintain. Thus, it is the predetermined electrical potential difference VH about the output voltage of a piezoelectric transformer 1, controlling the output of a chopper 21. Time amount t2 after controlling and giving the impression time amount of starting voltage required for positive starting lighting of a electric-discharge lamp RL, before becoming time amount inadequate for circuit protection A timer circuit 14 passes the deadline of, actuation of the PWM control circuit 22 is stopped, and an output is made into zero (drawing 7 (a)). Or the output of a chopper 21 is reduced and the output voltage of a piezoelectric transformer 1 is reduced (drawing 7 (b)).
[0047] The increment in stress for destruction of a piezoelectric transformer 1, a temperature rise, degradation, a switching device, an inductance component of an inverter 11, etc., insulating degradation of resin components, etc. are prevented without being continued to the time amount which can supply by this the electrical potential difference which can perform starting lighting of a electric-discharge lamp RL at the time of low temperature, and becomes inadequate [the high power condition of a piezoelectric transformer 1] for circuit protection also in no-load. Of course, risk of people receiving an electric shock in high pressure of several kV is [nothing] and is safe.
[0048] Moreover, actuation when the output section of the case where it separates while the electric-discharge lamp RL lit up, or a piezoelectric transformer 1 separates, and the operation effectiveness are the same as the operation gestalt 1. Furthermore, since input voltage to an inverter 11 is fixed by the chopper 21, it is not necessary by this operation gestalt to control a frequency to the voltage variation of DC power supply 10. For this reason, in the case of the operation gestalt 1 or the operation gestalt 2, if the narrow circuit system of a control frequency domain like the so-called push0pull circuit as circuitry of an inverter 11 is used, with this operation gestalt, the electrical-potential-difference range of fluctuation of DC power supply 10 can take very greatly to the electrical-potential-difference range of fluctuation of DC power supply 10 being restricted small, and keeping.
[0049] It is easy to be natural even if it uses the configuration of the operation gestalt 3 for a ****

operation gestalt.
(Operation gestalt 5) As this operation gestalt is what detected the input current to the piezoelectric transformer 1 which does not detect output voltage of a piezoelectric transformer 1 like the operation gestalt 4, but is proportional to the output voltage of a piezoelectric transformer 1 by the partial pressure resistance Ra and Rb and is shown in drawing 8 The partial pressure resistance Ra and Rb and diode D2 in a circuit of drawing 6 It removes, the input current detector 23 is inserted between an inverter 11 and a piezoelectric transformer 1, and it is diode D4 about the detection output of this input current detector 23. It minds and has connected with the PWM control circuit 22.
[0050] Since it ** and the input voltage to an inverter 11 is fixed by the chopper 21 in the circuit of this operation gestalt, it becomes fixed [the input voltage to a piezoelectric transformer 1], and the output voltage of a piezoelectric transformer 1 is proportional to the input current to a piezoelectric transformer 1. Therefore, if an input current is detected and controlled instead of the output voltage of a piezoelectric transformer 1, output voltage is controllable like said operation gestalt.
[0051] As for circuit actuation of this operation gestalt, the method of output voltage detection of a piezoelectric transformer 1 only differs from the operation gestalt 4, and since other actuation is the same as the operation gestalt 4, explanation is omitted. In addition, although the current flowed not only to the load current but to the partial pressure resistance Ra and Rb which flows to the electric-discharge lamp RL whose output current is a load when a electric-discharge lamp RL and juxtaposition have the partial pressure resistance Ra and Rb at the output section of a piezoelectric transformer 1 and it had been lost with the operation gestalt 4, since input current detection of a piezoelectric transformer 1 performs output voltage detection in the case of this operation gestalt, the above-mentioned loss is lost and circuit efficiency can be improved.
[0052] (Operation gestalt 6) Although this operation gestalt is the same as the circuitry of drawing 1 of the operation gestalt 1 as shown in drawing 9 The output voltage of a piezoelectric transformer 1 is the predetermined electrical potential difference VH, without making a timer circuit 14 count from the time of circuit actuation initiation with this operation gestalt. After reaching, so that it may begin to count An integrator 13 is the predetermined electrical potential difference VH. The output when detecting is given to a timer circuit 14, and the timer circuit 14 has started count actuation.
[0053] In the case of the operation gestalt 1, the output voltage of the piezoelectric transformer 1 at the time of no-load is the predetermined electrical potential difference VH by the difference (difference in the magnitude of supply voltage) in the magnitude (I and RO show by a diagram) of the input voltage given to a piezoelectric transformer 1 as shown in drawing 10 . The time amount to attain differs, that is, it is VH of high power. It has generated and time amount differs (ta and tb). If a high power condition is too long like because of the dispersion (for example, ta), neither a piezoelectric transformer 1 nor stress, such as a switching device, or if a high power condition is too short like tb, positive starting lighting of a electric-discharge lamp RL may become impossible.
[0054] On the other hand, in the case of this operation gestalt, for a timer circuit 14, the output voltage of a piezoelectric transformer 1 is VH. Even if it changes sharply the input voltage (supply voltage) to a piezoelectric transformer 1 since a count is started after becoming, it is the predetermined electrical potential difference VH. Being able to set constant the time amount to output, the problem in the above-mentioned operation gestalt 1 does not occur. In addition, since other actuation is the same as the operation gestalt 1, explanation is omitted.
[0055] (Operation gestalt 7) Like the operation gestalt 2, this operation gestalt has the description in the point using a counter circuit 24, as the output voltage of the letter of a burst is shown in drawing 11 instead of a timer circuit 14 and the lighting distinction circuit 15 in the circuitry which carries out predetermined time generating from a piezoelectric transformer 1 at the time of no-load. That is, it sets at the time of no-load, and the output voltage of a piezoelectric transformer 1 is the predetermined electrical potential difference VH. If it reaches, a comparator 16 will give a signal to V-F converter 12, when the output is given to a counter circuit 24, a counter circuit 24 counts the count (count which reached the predetermined electrical potential difference VH) and a predetermined count is counted, and will restrict or stop that signalling frequency is outputted from V-F converter 12. For a counter circuit

24, the output voltage of a piezoelectric transformer 1 is the predetermined electrical potential difference VH. If the attained count does not turn into a predetermined count, in order not to give a signal to V-F converter 12, that is, not to restrict or suspend an output, when the load slack electric-discharge lamp RL is connected, a electric-discharge lamp RL lights up, and the output voltage of a piezoelectric transformer 1 is always the predetermined electrical potential difference VH. It becomes the following and lighting is maintained.

[0056] the difference in the magnitude of the output voltage which in the case of the operation gestalt 2 is given to a piezoelectric transformer 1 here as drawing 12 boils and shows the output voltage of the piezoelectric transformer 1 at the time of no-load (as for I, in the difference in the magnitude of supply voltage, and drawing, RO shows the case of being small for the case of being large) -- it is -- predetermined electrical potential difference VH the time amount to attain -- differing -- VH The counts to attain also differ. It is large because of this dispersion (for example, input voltage), and the output voltage of a piezoelectric transformer 1 is the predetermined electrical potential difference VH. If the count to attain increases too much, stress, such as a piezoelectric transformer 1 and a switching device, increases, input voltage is conversely small, and the output voltage of a piezoelectric transformer 1 is the predetermined electrical potential difference VH. If there are too few counts to attain, positive starting lighting of a electric-discharge lamp RL may become impossible.

[0057] On the other hand, in the case of this operation gestalt, for the count circuit 24, the output voltage of a piezoelectric transformer 1 is VH. Even if it counts the count which became and changes sharply the input voltage (supply voltage) to a piezoelectric transformer 1, predetermined carries out a count output and the problem in the above-mentioned operation gestalt 2 does not occur. Moreover, since a lighting distinction circuit 15 like the operation gestalt 2 is unnecessary, reduction and low-cost-izing of the number of components can be attained.

[0058] In addition, since other actuation is the same as the operation gestalt 2, explanation is omitted.

(Operation gestalt 8) This operation gestalt gives the function of the lighting distinction circuit 15 in the operation gestalt 2 to an integrator 13, as shown in drawing 13 . that is, the load current which detected the integrator 13 -- reference voltage Vref1 it is operating so that it may compare and may become the predetermined load current, but while the integrator 13 can be controlling to the predetermined load current, as for an integrator 13, a timer circuit 14 gives the signal of load limitation or an output halt to V-F converter 12 -- it stops. Moreover, when it becomes impossible to control to the predetermined load current (unloaded condition etc.), a timer circuit 14 makes it, as for an integrator 13, start to give the signal of load limitation or an output halt to V-F converter 12.

[0059] Thereby, since a lighting distinction circuit is made to serve a double purpose with an integrator 13 in the case of this operation gestalt, reduction and low-cost-izing of the number of components can be attained. Moreover, since it becomes impossible to control the load current to the predetermined load current and the output of a piezoelectric transformer 1 is restricted or stopped when it is made to operate on the conditions exceeding the engine performance of a circuit (for example, when supply voltage is very small etc.), circuit protection can be planned to use exceeding the circuit engine performance.

[0060] In addition, since other configurations and actuation are the same as the operation gestalt 1, explanation is omitted.

(Operation gestalt 9) This operation gestalt gives the function of the lighting distinction circuit 15 in the operation gestalt 4 to an integrator 13, as shown in drawing 14 . that is, the load current which detected the integrator 13 -- reference voltage Vref1 it is operating so that it may compare and may become the predetermined load current, but while the integrator 13 can be controlling to the predetermined load current, as for an integrator 13, a timer circuit 14 gives the signal of load limitation or an output halt to the PWM control circuit 22 -- it stops. Moreover, when it becomes impossible to control to the predetermined load current (unloaded condition etc.), a timer circuit 14 makes it, as for an integrator 13, start to give the signal of load limitation or an output halt to the PWM control circuit 22.

[0061] Thereby, in the case of this operation gestalt, since a lighting distinction circuit is made to serve a double purpose with an integrator 13, reduction and low-cost-izing of the number of components can be attained. Moreover, since it becomes impossible to control the load current to the predetermined load

current and the output of a piezoelectric transformer 1 is restricted or stopped when it is made to operate on the conditions exceeding the engine performance of a circuit (for example, when supply voltage is very small etc.), circuit protection can be planned to use exceeding the circuit engine performance.
[0062] In addition, since other configurations and actuation are the same as the operation gestalt 4, explanation is omitted.
(Operation gestalt 10) Although this operation gestalt applies to the configuration of the operation gestalt 1 (or operation gestalt 2) fundamentally, when the switching devices 26, such as an analog switch, are formed between DC power supply 10 and an inverter 11 as shown in drawing 15 , and a timer circuit 14 passes the deadline of at the time of no-load, it makes a switching device 26 turn off and intercepts a power source. At this time, V-F converter 12 shall continue giving signalling frequency to an inverter 11.
[0063] In the circuit shown in the operation gestalten 1 and 2 here as an inverter 11 As shown in drawing 16 , it is a switching device Q1 and Q2. It turns on and off by turns. The inductance component L1 and L2 When the push0pull circuit which can give the abbreviation sinusoidal voltage which doubled [more than] the pressure up of the electrical potential difference of DC power supply 10 using the energy accumulated to the primary electrodes 7a and 7b of a piezoelectric transformer 1 is used, there are the following problems.
[0064] That is, if a timer circuit 7 passes the deadline of at the time of no-load and actuation of V-F converter 12 is stopped Switching device Q1 And Q2 It will turn off in coincidence and is the inductance component L1. Or L2 The accumulated energy is not given to a piezoelectric transformer 1. Switching device Q1 And Q2 It is emitted through stray capacity etc. and is a switching device Q1 and Q2. The high voltage which gives stress will occur.
[0065] The direction (at for example, the time of high power like the predetermined electrical potential difference VH) when the output voltage of a piezoelectric transformer 1 is high is the inductance component L1 and L2. The switching device Q1 when the energy accumulated being also large and stopping it, and Q2 The stress to generate becomes large (the electrical potential difference to generate becomes high). However, even if according to the configuration of this operation gestalt a timer circuit 14 passes the deadline of at the time of no-load, it turns off a switching device 26 and it stops an output, it is the inductance component L1 and L2. The accumulated energy (current 9) is a piezoelectric transformer 1 and a switching device Q1. Or Q2 It is minded and emitted and is a switching device Q1 and Q2. Stress is not made to increase.
[0066] in addition, although drawing 15 shows the place of an important section notionally and omits and shows the lighting distinction circuit 15 and the circuit of integrator 13 grade, it comes out not to mention being equipped like the operation gestalt 1 or the operation gestalt 2.
(Operation gestalt 11) Fundamentally, this operation gestalt applies to the configuration of the operation gestalt 4 (or operation gestalt 5), as shown in drawing 17 , but when a timer circuit 14 passes the deadline of at the time of no-load, V-F converter 12 continues giving signalling frequency to an inverter 11, stops actuation of a chopper 21, and acquires the same operation effectiveness as the operation gestalt 12.
[0067] in addition, although drawing 17 shows the place of an important section notionally, and the PWM control circuit 22, the lighting distinction circuit 15, and the circuit of integrator 13 grade are omitted and shown, it comes out not to mention being equipped like the operation gestalt 3 or the operation gestalt 4.
This operation gestalt is the thing made to correspond to the operation gestalt 1, the operation gestalt 2, and the operation gestalt 4. (Operation gestalt 12) In the circuit of each operation gestalt Impression time amount [of the output voltage of the piezoelectric transformer 1 required for positive actuation of a electric-discharge lamp RL at the time of no-load] (t1) after, After the fall of a switch in a high frequency or the output of a chopper 21 restricts the output voltage of a piezoelectric transformer 1 small by the time amount t2 (shown [in the case of the operation gestalt 1 / in the case of drawing 18 and the operation gestalt 2] at drawing 20 , respectively in the case of drawing 19 and the operation gestalt 4) before becoming time amount inadequate for circuit protection, Actuation of V-F converter 12 or a

chopper 21 is stopped, and an output is stopped (time amount t3).
[0068] Since the output voltage of a piezoelectric transformer 1 is small and it is restricted when stopping an output, even if it uses a push0pull circuit as shown to an inverter 11 that this explained with the operation gestalt 10 at drawing 16 , it is a switching device Q1 and Q2. The stress to generate can be stopped small and, as a result, it is a switching device Q1 and Q2. It can be managed even if it does not use a pressure-proof big thing.
[0069]
[Effect of the Invention] In the electric-discharge lamp lighting device which invention of claim 1 is equipped with the inverter which changes direct current voltage into alternating voltage, and the piezoelectric transformer which considers output voltage of this inverter as an input, and impresses the output voltage of this piezoelectric transformer to a electric-discharge lamp The output voltage of a piezoelectric transformer above the minimum electrical potential difference which can put a electric-discharge lamp into operation at the time of no-load or starting And a means to restrict on a predetermined electrical potential difference smaller than the electrical potential difference which a piezoelectric transformer destroys, Above electrical-potential-difference impression time amount required for positive starting of a electric-discharge lamp, and after predetermined time progress smaller than the time amount which becomes inadequate for circuit protection, Since it had a means to stop a fall or generating of output voltage for the output voltage of a piezoelectric transformer rather than said predetermined electrical potential difference when lighting of a electric-discharge lamp was not checked It is not continued until it can ensure starting lighting of a electric-discharge lamp at the time of low temperature and the high power condition of a piezoelectric transformer serves as time amount with inadequate circuit protection at the time of no-load. Destruction of a piezoelectric transformer, a temperature rise, and property degradation can be prevented, and prevention of prevention of the increment in stress of the switching device used for an inverter or an inductance component, insulating degradation of resin components, etc. can be aimed at, and there is no risk of people receiving an electric shock to the high voltage further, and it is effective in being safe.
[0070] In invention of claim 1, invention of claim 2 adjusts output voltage of a piezoelectric transformer by frequency control, and has the same effectiveness as invention of claim 1. In invention of claim 2, when lighting of a electric-discharge lamp is not checked, invention of claim 3 makes a frequency high, reduces the output voltage of a piezoelectric transformer, and has the same effectiveness as invention of claim 2.
[0071] Since it is controlled by frequency control which repeats returning to a high frequency after it returns it to a high frequency after the output voltage of the piezoelectric transformer within predetermined time carried out the sweep of the invention of claim 4 to the low frequency from the high frequency in invention of claim 3, and it carries out a sweep to a low frequency again, it is effective in the stress to a piezoelectric transformer and the stress to the switching device of an inverter being mitigable in addition to the effectiveness that invention of claim 3 does so.
[0072] Invention of claim 5 does so claim 1 thru/or the same effectiveness as invention of 4 in claim 1 thru/or invention of 4 by being characterized by using quantity of electricity proportional to the amount of output voltage, or output voltage for detection of the output voltage of a piezoelectric transformer. Invention of claim 6 is effective in the ability to be able to lower the proof-pressure engine performance of the component which can detect to detection of the output voltage of a piezoelectric transformer using an electrical potential difference smaller than the output voltage generated in the secondary electrode of a piezoelectric transformer since the voltage obtained from the detection electrode prepared in the location where the amplitude of a piezoelectric transformer serves as abbreviation 0 is used, therefore is used for it in claim 1 thru/or invention of 4 in the circuit for detection.
[0073] In invention of claim 1, since invention of claim 7 used the input voltage control means which adjusts output voltage of a piezoelectric transformer by control of input voltage, even if it does not need to perform control by the frequency control of an inverter etc. by controlling by the input voltage side even if it has fluctuation of direct current voltage, therefore uses the small thing of a control frequency domain for an inverter, it is effective in the ability to enlarge the range of fluctuation of direct current

voltage.

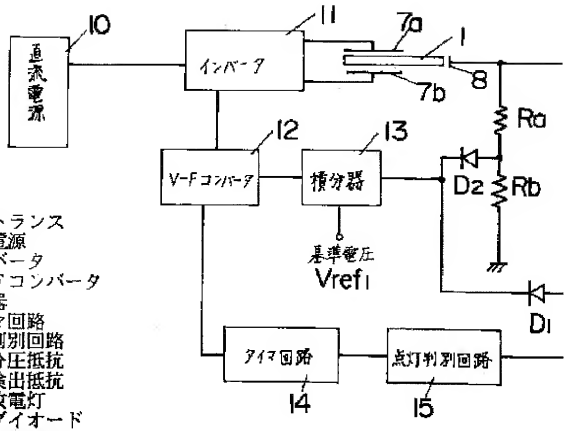
[0074] Since invention of claim 8 constituted the input voltage control means from a chopper or an analog switch in invention of claim 7, the same effectiveness as invention of claim 7 is acquired. In invention of claims 7 and 8, since invention of claim 9 detects the output voltage of a piezoelectric transformer from the amount of input currents of a piezoelectric transformer, it can abolish the loss which a current flows and generates and the effectiveness that circuit efficiency can be improved is in the circuit for output voltage detection. Invention of claim 10 counts predetermined time from circuit actuation time of day in claim 1 thru/or invention of 9, and the effectiveness which does so by claim 1 thru/or invention of 9 is acquired. Since invention of claim 11 counts predetermined time in claim 1 thru/or invention of 9 from the time of day when the output voltage of a piezoelectric transformer reached the predetermined electrical potential difference, it is effective in being able to set constant time amount which outputs a predetermined electrical potential difference, even if it changes the input voltage of a piezoelectric transformer sharply, therefore losing the increment in the stress to the piezoelectric transformer and switching device by dispersion, failure in starting lighting, etc., being stabilized, and actuation being obtained.

[0075] Invention of claim 12 is time amount and a match when the count to which the output voltage of a piezoelectric transformer reached [predetermined time] the predetermined electrical potential difference in invention of claim 4 turns into a count of predetermined, does not have the effect of the difference in the magnitude of the input voltage of a piezoelectric transformer etc., and is effective in the ability to lose a piezoelectric transformer, the increment in the stress to a switching device, failure in starting lighting, etc.

[0076] In claim 1 thru/or invention of 12, since invention of claim 13 stops an output after reducing the output voltage of a piezoelectric transformer rather than a predetermined electrical potential difference when lighting of a electric-discharge lamp is not checked, there is effectiveness that the stress which joins the switching device of an inverter can be reduced, at the time of a halt. In claim 1 thru/or invention of 13, since invention of claim 14 used the circuit which performs feedback control of the load current as an inverter, in addition to the effect of the invention of claim 1 thru/or claim 13, it can control the output of an inverter so that the load current becomes fixed.

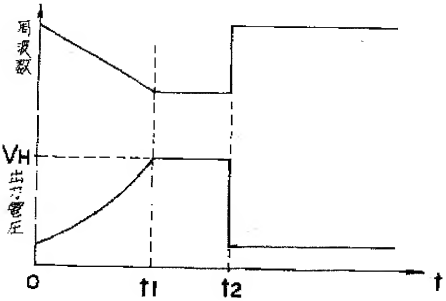
[0077] In invention of claim 14, since invention of claim 15 made the means of lighting distinction of a electric-discharge lamp serve a double purpose with the means of the feedback control of the load current, the means of lighting distinction becomes unnecessary and it is effective in the ability to attain reduction and low-cost-izing of the number of components. In claims 14 and 15, invention of claim 16 is what was constituted from a V-F converter to which the load current is detected for the means of the feedback control of the load current, and the drive frequency of an inverter is changed in response to the output voltage of the integrator in comparison with reference voltage, and this integrator, and is effective in the ability to constitute from an easy circuit.

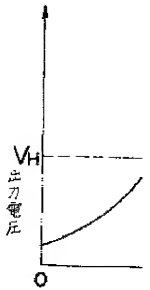
[Translation done.]



1　圧電トランス
10　直流電源
11　インバータ
12　V－Fコンバータ
13　積分器
14　タイマ回路
15　点灯判別回路
Ra，Rb　分圧抵抗
R　検出抵抗
RL　放電灯
D_1，D_2　ダイオード
$Vref_1$　基準電圧

(a)





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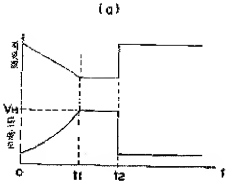

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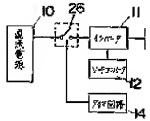

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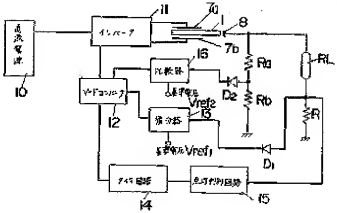

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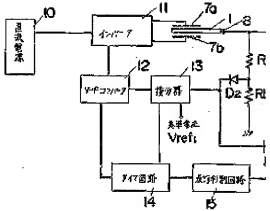

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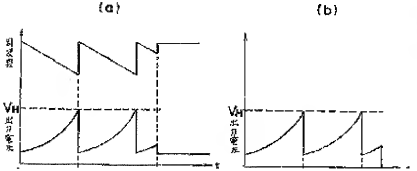

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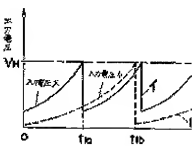

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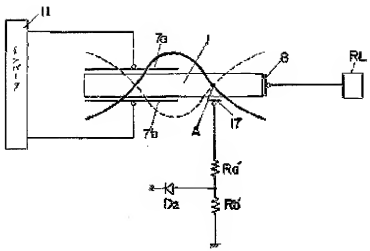

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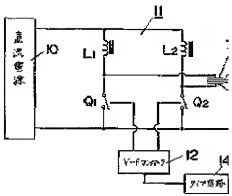

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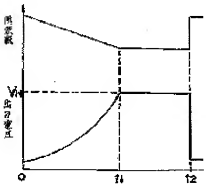

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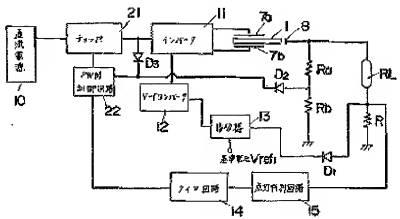

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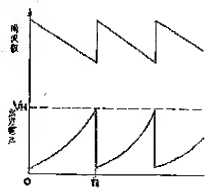

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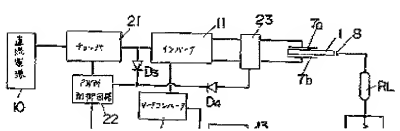

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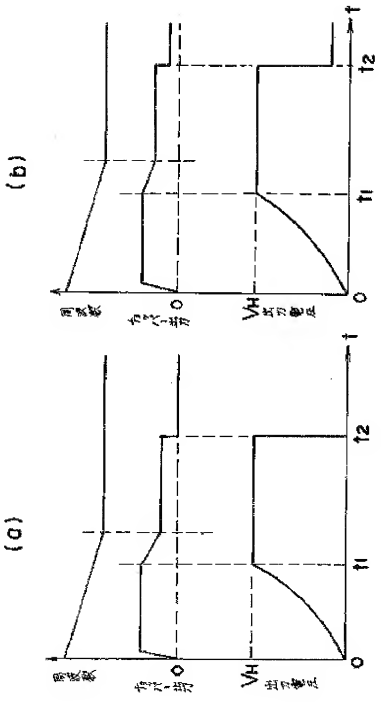

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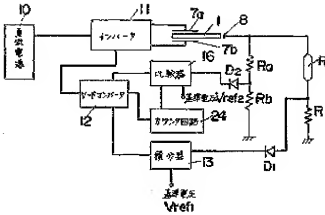

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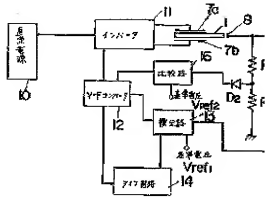
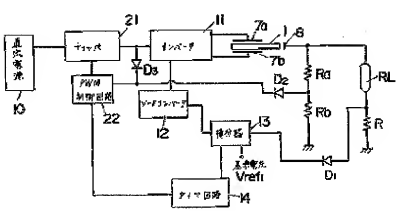
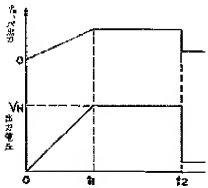


【図２０】

【図１４】





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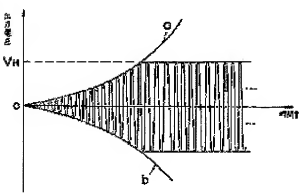

【図２３】